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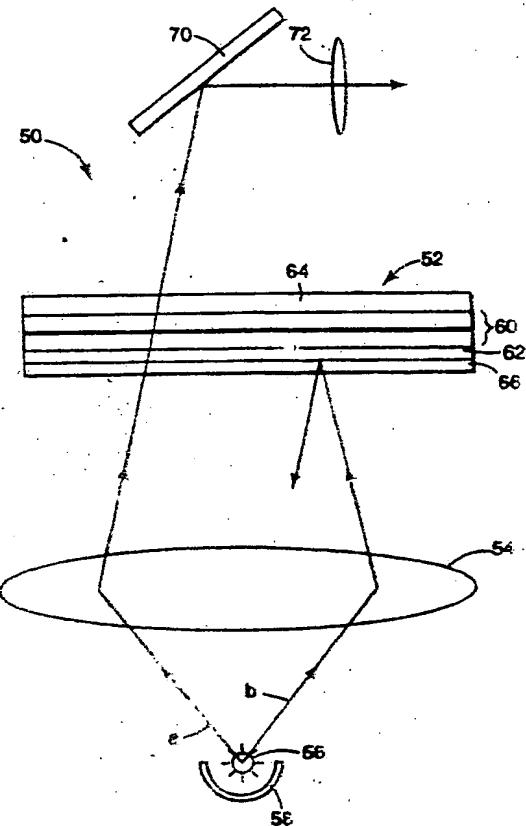
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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## (54) Title: LIQUID CRYSTAL DISPLAY PROJECTION SYSTEM USING MULTILAYER OPTICAL FILM POLARIZERS

## (57) Abstract:

A liquid crystal display (LCD) projection system (50) including a projection panel (52), a light source (56), and a reflector (58). The projection panel includes an LCD (60) and a polarizer (64) on one side of the LCD and a reflective polarizer (62) on the other side. The reflective polarizer is a multilayer stack of pairs (44) of adjacent material layers (41, 43). Each of the layer pairs exhibits a refractive index difference between the adjacent layers in a first direction in the plane of the reflective polarizer and exhibits essentially no refractive index difference between adjacent layers in a second direction in the plane of the reflective polarizer and orthogonal to the first direction. A quarter-wave plate (66) is secured to the reflective polarizer. Light rays from the light source either pass through the reflective polarizer and on to the LCD, or are reflected back toward the light source, depending on their polarization. Light which is reflected by the reflective polarizer is reflected by the reflector back toward the LCD again. The use of the quarter-wave plate and the reflector help to recycle what would typically be regarded as wasted light, while at the same time reducing heat build-up within the LCD.



We claim:

1. A liquid crystal display projection system (10), comprising:
  - a projection panel (12), comprising:
    - 5 a liquid crystal display (20); and
    - a pair of dichroic polarizers (22, 24), wherein one polarizer is provided adjacent each side of the display;
  - 20 a light source (16) for directing light toward the panel; and
  - 25 a reflective prepolarizer (26) comprising a multilayer optical film (36) provided between the light source and the dichroic polarizer facing the light source, the film comprising a multilayered stack of pairs (44) of adjacent material layers, each of the layer pairs exhibiting a refractive index difference between the adjacent layers (41, 43) in a first direction in the plane of the reflective prepolarizer and exhibiting essentially no refractive index difference between adjacent layers in a second direction in the plane of the reflective prepolarizer and orthogonal to the first direction.
2. The system of claim 1, wherein the film comprises a plurality of alternating layers of semi-crystalline naphthalene dicarboxylic acid polyesters and another polymer.
3. The system of claim 1, further comprising:
  - 25 a quarter-wave plate (28) provided between the light source and the reflective prepolarizer; and
  - 30 a reflector (18) provided on the side of the light source opposite the panel.
4. The system of claim 1, further comprising a reflective polarizer provided between the liquid crystal display and the dichroic polarizer on the side of the liquid

5 crystal display opposite the light source, the reflective polarizer comprising a multi-layer optical film (36) comprising a multilayered stack of pairs (44) of adjacent material layers, each of the layer pairs exhibiting a refractive index difference between the adjacent layers (41, 43) in a first direction in the plane of the reflective polarizer and exhibiting essentially no refractive index difference between adjacent layers in a second direction in the plane of the reflective polarizer and orthogonal to the first direction.

10 5. A liquid crystal display projection system (50), comprising:  
a projection panel (52), comprising:  
a liquid crystal display (60);  
a first polarizer (64) provided on one side of the display; and  
a second polarizer (62), which is a reflective polarizer, provided  
on the other side of the display, wherein the second  
polarizer comprises a multilayer optical film (36)  
comprising a multilayered stack of pairs (44) of adjacent  
material layers, each of the layer pairs exhibiting a  
refractive index difference between the adjacent layers  
(e.g., 43) in a first direction in the plane of the reflective  
polarizer and exhibiting essentially no refractive index  
difference between adjacent layers in a second direction  
in the plane of the reflective polarizer and orthogonal to  
the first direction; and  
20 a light source (56) for directing light toward the second polarizer.

25        6. The system of claim 5, further comprising a third polarizer, which is a reflective polarizer, provided between the first polarizer and the liquid crystal display, the third polarizer comprising a multilayered stack of pairs (44) of adjacent material layers, each of the layer pairs exhibiting a refractive index difference between the adjacent layers (41, 43) in a first direction in the plane of the third polarizer and exhibiting essentially no refractive index difference between adjacent layers in a second direction in the plane of the third polarizer and orthogonal to the first direction.

7. The system of claim 5, wherein the first polarizer is a reflective polarizer comprising a multilayered stack of pairs (44) of adjacent material layers, each of the layer pairs exhibiting a refractive index difference between the adjacent layers (41, 43) in a first direction in the plane of the first polarizer and exhibiting essentially no refractive index difference between adjacent layers in a second direction in the plane of the first polarizer and orthogonal to the first direction.

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8. The system of claim 7, further comprising:  
10 a quarter-wave plate (66) provided between the light source and the second polarizer; and  
a reflector (58) provided on the side of the light source opposite the panel.

15 9. A liquid crystal panel, comprising:  
a liquid crystal display (60);  
a first polarizer (64) secured to one side of the display;  
20 a second polarizer (62), which is a reflective polarizer, secured to the other side of the display, wherein the second polarizer comprises a multilayer optical film (36) comprising a multilayered stack of pairs (44) of adjacent material layers, each of the layer pairs exhibiting a refractive index difference between the adjacent layers (41, 43) in a first direction in the plane of the reflective polarizer and exhibiting essentially no refractive index difference between adjacent layers in a second direction in the plane of the reflective polarizer and orthogonal to the first direction; and  
25 a quarter-wave plate (66) secured to the second polarizer.

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10. An overhead projector (132), comprising, in order:  
30 a projection lamp (122);  
a converging lens (124);

10 a quarter-wave plate (126) secured to the converging lens; and a reflecting polarizer (128) secured to the quarter-wave plate, the reflecting polarizer comprising a multilayer optical film (36) comprising a multilayered stack of pairs (44) of adjacent material layers, each of the layer pairs exhibiting a refractive index difference between the adjacent layers (41, 43) in a first direction in the plane of the reflective polarizer and exhibiting essentially no refractive index difference between adjacent layers in a second direction in the plane of the reflective polarizer and orthogonal to the first direction.

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11. A liquid crystal display projection system (140), comprising in order: an overhead projector (142); an adapter panel (150) provided on the projector, the adapter panel comprising a quarter-wave plate (144) and a reflecting polarizer (146), the reflecting polarizer comprising a multilayer optical film (36) comprising a multilayered stack of pairs (44) of adjacent material layers, each of the layer pairs exhibiting a refractive index difference between the adjacent layers (41, 43) in a first direction in the plane of the reflective polarizer and exhibiting essentially no refractive index difference between adjacent layers in a second direction in the plane of the reflective polarizer and orthogonal to the first direction; and a liquid crystal display projection panel (148) provided on the adapter panel, the projection panel comprising a liquid crystal display and a pair of dichroic polarizers provided on opposite sides of the display.

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